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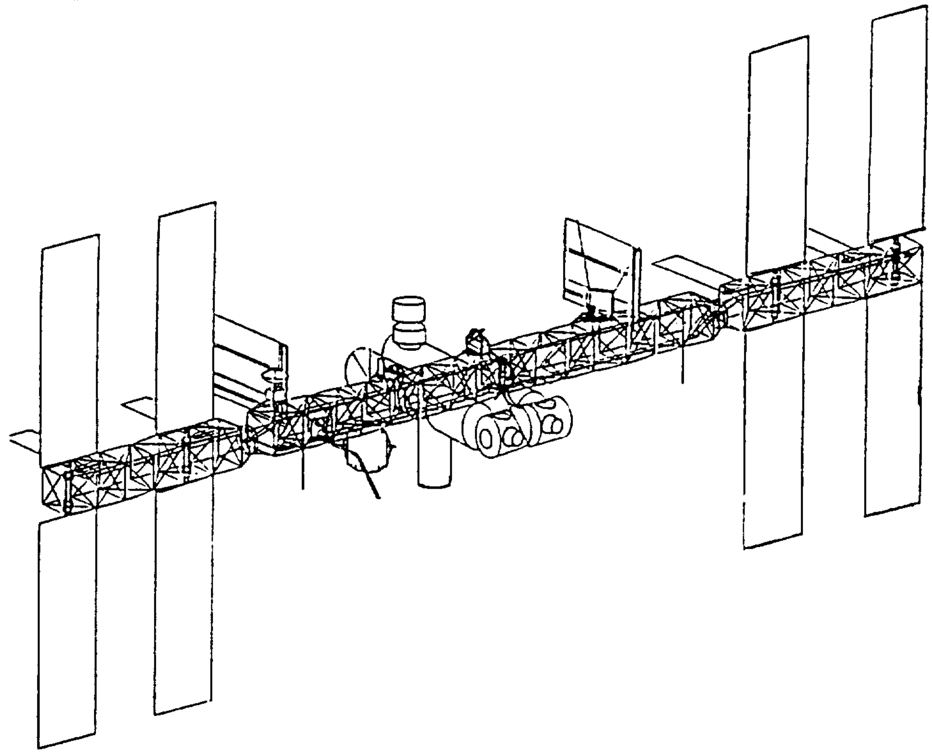
SPACE STATION

ATTACHED PAYLOAD

OSSA Attached Payloads Research Program



Goals and Objectives:

The Office of Space Science and Applications (OSSA) supports the development and flight of Space Station Freedom attached payloads which will be used to conduct scientific research in the disciplines of Astrophysics, Solar System Exploration, Space Physics, Earth Science and Applications, Communications and Information Systems, and Life Sciences. These various disciplines encompass wide-ranging scientific objectives in an endeavor to understand the origin and fundamental laws of the universe, the solar system, the sun and the earth, and to establish the scientific and technical foundation upon which to undertake both manned and unmanned explorations of the solar system.

Facility Descriptions:

The Space Station Utilization Branch within OSSA's Flight Systems Division manages the OSSA Attached Payloads Program. At the present time, 14 payloads have been selected as candidates for flight on Space Station Freedom. These payloads are: Cosmic Dust Orbit and Capture Experiment (CDOCE), Clouds and the Earth's Radiant Energy System (CERES), Cosmic Dust Experiment (CODE), EXObiology Intact Capture Experiments (EXO-ICE), Heavy Nuclei Collector (HNC), Large Area Modular Array of Reflectors (LAMAR), Laser Communications Transceiver (LCT), Lightning Imaging Sensor (LIS), Large Isotope Spectrometer for Astromag (LISA), Stratospheric Aerosol and Gas Experiment III (SAGE III), Spectra, Composition, and Interaction of Nuclei above 10 TeV (SCIN), Ultra-High Resolution XUV Spectroheliograph (UHRXS), Measurement of Cosmic Rays (Wizard), and X-ray Background Survey Spectrometer (XBSS). In addition, two facility-class payloads will be developed for the station to accommodate both individual and team investigators: The Cosmic Dust Collection Facility (CDCF), and the Particle Astrophysics Magnet Facility (Astromag).

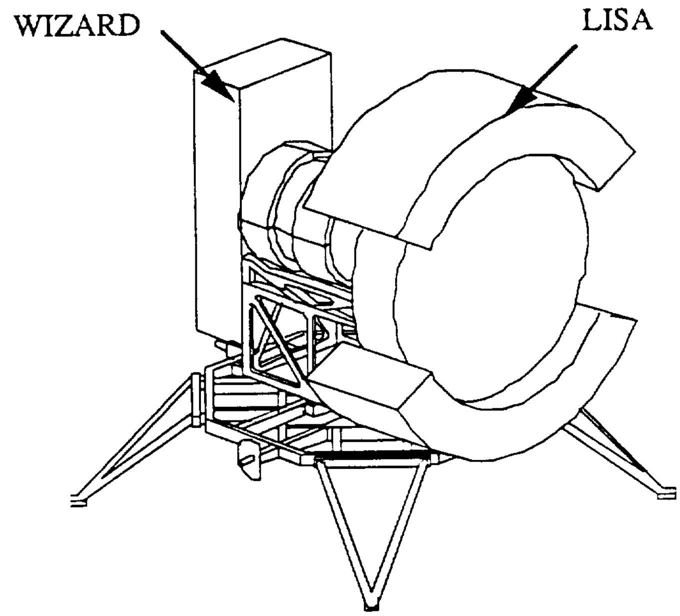
Management:

NASA Headquarters:
Dr. P. Cressy, Chief, Space Station Utilization Branch
Mr. M. Sistilli, Program Manager, Attached Payloads
Flight Systems Division
Office of Space Science and Applications

Measurement of Cosmic Rays (Wizard)

Payload Data:

Type:	Attached	*Mass:*	2593 kg
Launch:	TBD	*Size:*	4.5 x 1.5 x 3m
Lifetime:	2 1/2 years	*View Direction:*	Celestial



Objective:

Wizard will investigate cosmic ray antiprotons, positrons, and light nuclei (helium, lithium) and search for primordial antimatter. These studies are among the highest priority goals of particle astrophysics research, which was cited as key to understanding violent events in the universe by the National Research Council's Astronomy Survey Committee. Of crucial importance are the relative abundances and energy measurements of antiprotons and positrons, which are predominantly secondary in nature.

Description:

The Wizard experiment utilizes an array of particle detectors mounted in the strong magnetic field at one end of the Space Station Freedom Astromag facility. Wizard is modular and consists of a pair of time-of-flight detectors, a tracking system, transition radiation detectors, and a calorimeter. The time-of-flight detectors and the tracking system identify primordial matter. The transition radiation detector and the calorimeter provide the means for separately identifying light particles (e.g., electrons and positrons) from heavier particles (protons and antiprotons). The total instrument constitutes an array of detectors capable of identifying low-mass particles of matter and antimatter over a wide range of energies. Robotic installation and removal are planned.

Investigation Overview:

Quantifying the energy spectra will answer many questions in cosmic ray physics and particle astrophysics about the origin of antiprotons and positrons, selection and acceleration of particles, propagation history of individual components, effect of discrete sources, re-acceleration by instellar shock waves, and gas field systems in the Galaxy. The Wizard data will provide information on the antimatter/matter asymmetry of the universe, the mini black holes, and the role of the Grand Unified Theories in the early universe, all of which are relevant to both cosmology and elementary particle physics.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1998

Principal Investigator: Robert L. Golden, New Mexico State University

Management:

NASA Headquarters:

Program Manger (Attached Payload)	Mark Sistilli
Program Manager	Richard Howard
Program Scientist	W. Vernon Jones

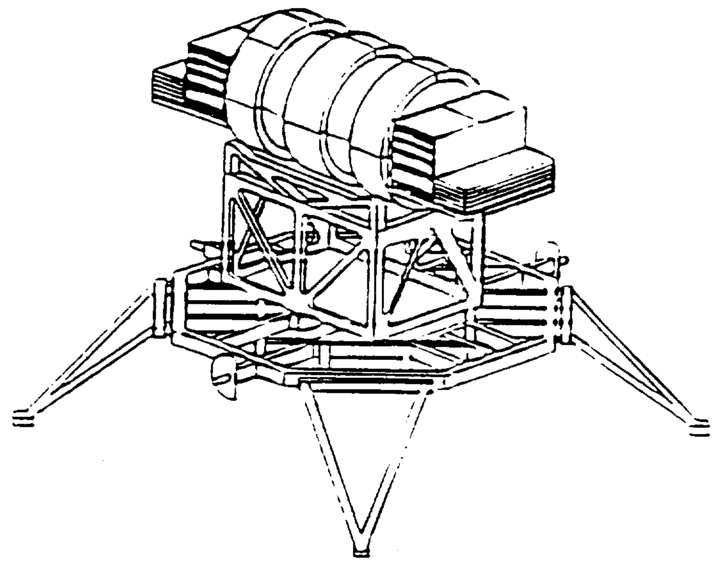
NASA Center:

Project Manager	TBD
Project Scientist	TBD

Spectra, Composition and Interaction of Nuclei above 10 TeV (SCIN)

Payload Data:

Type:	Attached	*Mass:*	(1200 kg) x 2
Launch:	TBD	*Size:*	(1.3 x 1.1 x 0.75m) x 2
Lifetime:	3 mo each (for 2 pallets)	*View Direction:*	Celestial



Objective:

SCIN is a high energy nuclear physics/particle astrophysics experiment which will be mounted on the Space Station Freedom Astromag Facility. The goal for SCIN is to measure the composition and spectra of the cosmic ray nuclei above 10^{14} eV and, using the magnetic field, to study the characteristics of nucleus-nucleus interactions above 10^{12} eV per nucleon.

Description:

The SCIN apparatus consists of two pallets, each with two passive emulsion chamber detectors that contain nuclear track emulsions, CR 39 plastic track-etch detectors, x-ray films, and lead, tungsten, or other inert materials. One chamber is similar to those flown on balloon-borne experiments to study cosmic ray compostion and interactions. The other, which contains a low-density target section designed to measure charge signs and transverse moments in the high fields of Astromag, is similar to a chamber exposed at the CERN heavy ion accelerator. Thermal control is achieved with coatings, insulation blankets, and electrical heaters. The instrument looks in the anti-Earth direction. Two 90 day exposures of the two pallet configurations are planned. SCIN is designed for robotics installation and removal of the pallets. The emulsion chamber analysis will follow post flight measurements of the track-sensitive detectors.

Investigation Overview:

Cosmic ray particles appear to contain nuclei of all elements found on Earth and are known to possess energies up to at least 10^{20} eV per particle. Pervading the Galaxy, and probably beyond, cosmic rays are a probe of high energy processes occurring in the Galaxy, and they tie together much of the field of high energy astrophysics. Their origin and acceleration is intimately linked to the origin of the elements themselves; their propagation and confinement depends on the structure of the Galaxy and it's magnetic field. The nuclear interactions of the highest energy particles permit investigations of the particle production process beyond accelerator energies, including a search for the postulated new phase of matter, quark-gluon plasma.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1998

Principal Investigator: Thomas A. Parnell, NASA/MSFC

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Richard Howard
Program Scientist	W. Vernon Jones

NASA Center:

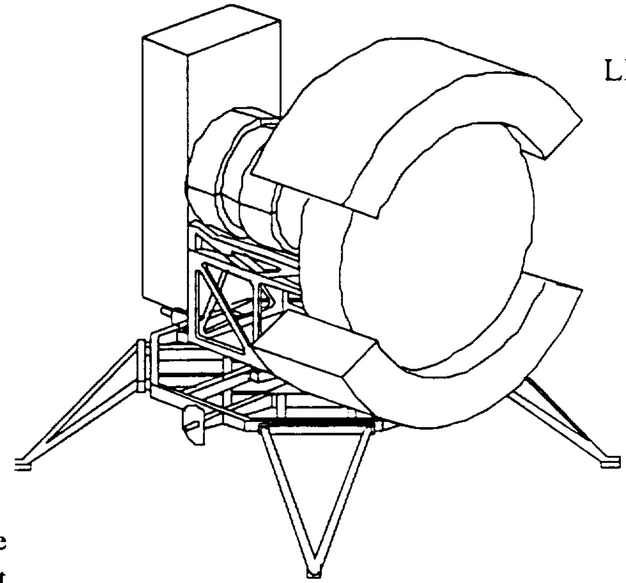
Project Manager	TBD
Project Scientist	TBD

Large Isotope Spectrometer for Astromag (LISA)

Payload Data:

Type: Attached
Launch: TBD
Lifetime: 2 years

Mass: 2400 kg
Size: 4.5 (diameter) x 2.25m
View Direction: Celestial



Objective:

LISA is a cosmic ray isotope spectrometer designed to identify isotopes in cosmic rays using the magnet/Cherenkov/time-of-flight method. Lisa will conduct high precision measurements to further our understanding of galactic material from beyond the solar system. The relative abundances of the elements and isotopes in galactic cosmic rays represent a record of the history and samples of matter from other regions of the galaxy, including its synthesis in stars, its acceleration to high energy, and its subsequent nuclear and electromagnetic interactions with the interstellar medium.

Description:

LISA consists of a modular combination of scintillating-optical-fibre trajectory detectors, Cherenkov velocity detectors, and time-of-flight scintillators in the magnetic field at one end of the Astromag facility. The scintillators measure time-of-flight and particle charge, Cherenkov counters measure particle velocity, Aerogel Cherenkov counters measure momentum per nucleon, and the scintillating optical fibre trajectory detectors measure two-dimensional track coordinates in the magnetic field. LISA's cylindrical configuration makes optimal use of the high field region near the Astromag magnet coil. By combining the individual measurements it is possible to identify: 1) nuclear charge; 2) isotopic mass; and, 3) whether the particles are matter or antimatter. The preferred observation direction is local zenith, with a fan-shaped beam field of view of 110 x 15 degrees.

Investigation Overview:

One of the fundamental yet unanswered questions of cosmology is the degree to which the universe contains antimatter. LISA will search for heavy antinuclei in the cosmic radiation with a sensitivity that is two orders of magnitude better than existing limits. Specifically, LISA will address investigations of: the origin and evolution of galactic matter; the acceleration, transport, and time scales of cosmic rays in the Galaxy; and the presence or lack of antimatter in the universe. The Astromag facility offers the opportunity for LISA to extend high-resolution spectroscopic studies of individual cosmic ray elements and isotopes by about an order of magnitude in energy/nucleon. LISA will be "tuned" to resolve isotopes from Be to Zn.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1999

Principal Investigator: Johnathan F. Ormes, NASA/GSFC

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Richard Howard
Program Scientist	W. Vernon Jones

NASA Center:

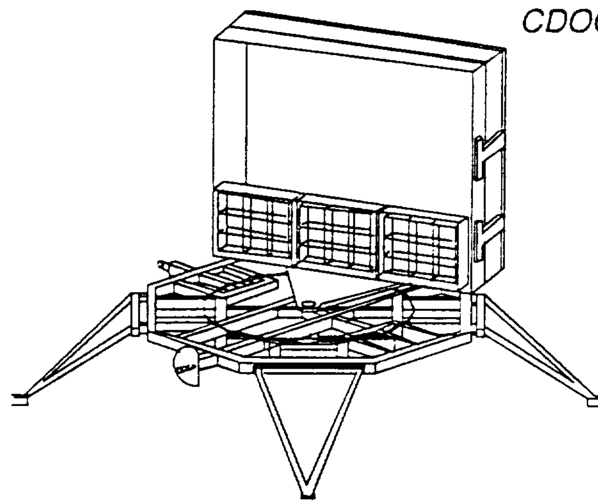
Project Manager	TBD
Project Scientist	TBD

Cosmic Dust Experiment (CODE)

Payload Data:

Type:	Attached	*Mass:*	129 kg
Launch:	TBD	*Size:*	1 x 1 x 0.3m (per module)
Lifetime:	10 years	*View Direction:*	Station anti-velocity direction (no Earth)

CDCF
CODE
EXO-ICE
CDOCE



Objective:

CODE will measure the sizes, fluxes, and trajectories of cosmic dust arriving at the Space Station Freedom and capture the dust for post-flight microscopic analysis. The analysis of impact debris from the dust particles coupled with trajectory data will answer the scientific question of whether particles of different compositional and structural types have different classes of orbits.

Description:

CODE will be installed in the Cosmic Dust Collection Facility (CDCF). The CODE experiment is modular. Each module uses two polyvinylidene fluoride (PDVF) dust sensor arrays. The arrays are separated by a fixed distance in order to use particle time-of-flight to determine dust velocities. This is followed by a capture cell array consisting of a series of pure aluminum foils of increasing thickness. This array collects the fragments and debris for analysis. Specific impacts are correlated with known events timed by the PDVF detectors. Accurate trajectory information is obtained by measuring the impact coordinates on the first and second foils.

Investigation Overview:

The long range goals are to measure the elemental, isotopic, mineralogical, and molecular properties of the captured dust and relate them to the sources of the dust material using the trajectory information. Laboratory studies of interplanetary dust particles collected in the stratosphere have established these facts: 1) the microstructure and mineral assemblages on many interplanetary dust particles are different from those found in primitive meteorites, and 2) some particles are rich in the biogenic light elements (H, C and N) compared to primitive meteorites. Evidence for indigenous organic molecules has also been detected.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1996

Principal Investigator: Robert M. Walker, Washington University

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	William Quaide (Acting)
Program Scientist	TBD

NASA Center:

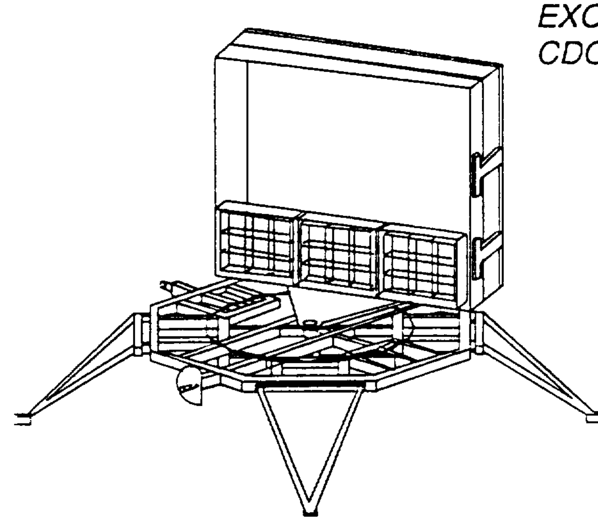
Project Manager	TBD
Project Scientist	TBD

Cosmic Dust Orbit and Capture Experiment (CDOCE)

Payload Data:

Type:	Attached	*Mass:*	23 kg
Launch:	TBD	*Size:*	1 x 0.8 x 1m (per module)
Lifetime:	10-20 years	*View Direction:*	Celestial

CDCF
CODE
EXO-ICE
CDOCE



Objective:

CDOCE will determine orbits of charged dust particles (near-earth containment, interplanetary, or interstellar material) with diameters of 10 micrometers to > 100 micrometers.

Description:

CDOCE will be installed in the Cosmic Dust Collection Facility (CDCF). Each dust particle entering the experiment aperture passes through a series of specially designed highly-transparent wire grids. Timing signals are generated by six sensing grids. The intervals between the six signals are used to uniquely determine the particle velocity vector. The velocity sensor can only record one event at a time. However, event repetition is measured in hours while particle dwell time in the sensor is approximately 1 millisecond; therefore ambiguities are minimized. The velocity detector can measure the relative particle velocity vector to an accuracy of 0.3 to 1% in magnitude and direction. The orbital velocity is used as a discriminator. If the velocity is less than 42 km/s, the orbit is elliptic and the particle is of solar system origin. If the velocity is greater than 42 km/s, the orbit is hyperbolic and the particle is of extra-solar system origin. Earth orbit debris is also distinguishable since it's geocentric velocity is smaller. The velocity vector is also used to calculate the impact point on the capture mechanism. The amplitudes of the six signals indicate the charge carried by the particle and provide an approximate indication of the particle's diameter. Additional shielding grids placed over the experiment aperture reduce interference by external fields and plasma.

Investigation Overview:

The goal of CDOCE is to correlate the captured charged dust particle trajectories with the interplanetary source body (comets, asteroids, etc.), or other sources (e.g., interstellar). In addition, CDOCE will allow for the detection and recovery of earth-orbiting debris and identification of debris sources.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1996

Principal Investigator: Siegfried Auer, Applied Research Corporation

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	William Quaide (Acting)
Program Scientist	TBD

NASA Center:

Project Manager	TBD
Project Scientist	TBD

EXObiology Intact Capture Experiments (EXO-ICE)

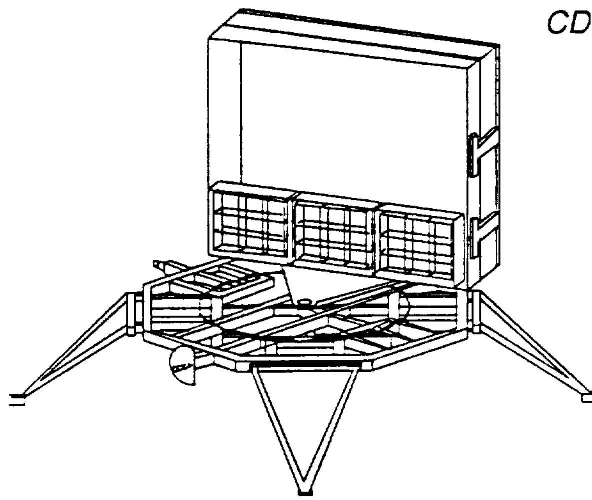
Payload Data:

Type:	Attached	*Mass:*	50 kg
Launch:	TBD	*Size:*	1 x 1 x 0.3m (per module)
Lifetime:	Multiple years	*View Direction:*	Station anti-velocity direction or Zenith

Objective:

EXO-ICE is an experiment to provide the intact capture and accurate tracking of hypervelocity cosmic dust. This will expand the existing scientific knowledge of the origin and history of biogenic elements and compounds by allowing the return of largely unaltered material to Earth for detailed analysis. The major benefit of returning intact cosmic dust for detailed laboratory examination is that the analysis can be conducted with powerful Earth-based instruments which are highly impractical for flight.

CDCF
CODE
EXO-ICE
CDOCE



Description:

EXO-ICE will be installed in the Cosmic Dust Collection Facility (CDCF). EXO-ICE consists of a single capture module containing a one square meter collection surface of "Aerogel" intact capture collection media together with acoustic impact sensors. Particle impact event timing provided by EXO-ICE, when correlated with particle trajectory information provided by another CDCF instrument, will enable investigators to determine the astrophysical source of the particles. The instrument looks in the anti-velocity vector direction of Space Station Freedom with a field of view of 1 π Steradian (over 60 % of the module). Anticipated lifetime is several years, with capture modules to be replaced robotically at 45 or 90 day intervals.

Investigation Overview:

Analyzing extra-terrestrial samples will help to answer many important exobiology-related questions about our solar system. The EXO-ICE instrument, unlike atomized capture techniques, will preserve all of the desired information pertinent to exobiology. The principal goal of exobiology is to understand the origin and evolution of life. EXO-ICE will broaden scientific knowledge in the understanding of: the elemental, molecular, and isotopic composition, and mineralogical, morphological, and phasal characteristics of cosmic dust; the relationships among comets, cosmic dust, meteorites, asteroids, and interstellar grains; the conditions in the solar nebula during solar formation and post formation alteration; and the relationships of cosmic dust to volatiles on the terrestrial planets. EXO-ICE will collect particles in the 50-200 micrometer region with a minimum of 25% mass recovery from four primary source regions: 1) comets, 2) asteroids, 3) interstellar clouds, and 4) stellar condensates. It is anticipated that EXO-ICE will capture 200 particles in this desired range over a two year period.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1996

Principal Investigator: Glenn C. Carle, NASA/ARC

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	William Quaide (Acting)
Program Scientist	TBD

NASA Center:

Project Manager	TBD
Project Scientist	TBD

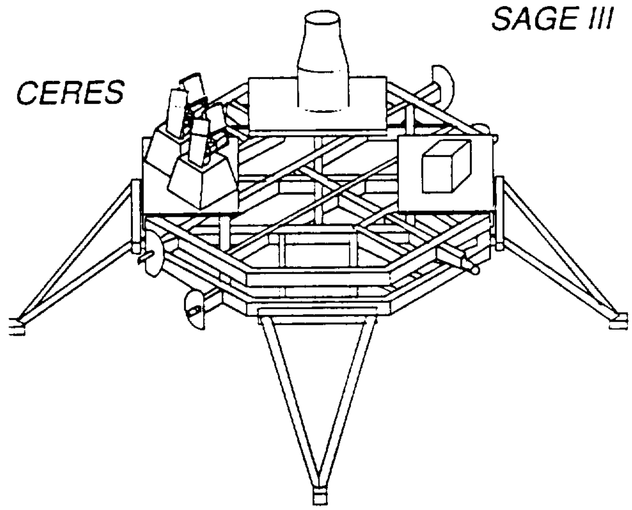
Clouds and the Earth's Radiant Energy System (CERES)

Payload Data:

Type:	Attached	*Mass:*	90 kg
Launch:	TBD	*Size:*	1.2 x 1 x 1.4m (total)
Lifetime:	>4years	*View Direction:*	Earth viewing/Nadir-centered

Objective:

CERES, an Earth observing payload, will directly contribute to the Earth Observing System (Eos) key Earth science tasks by quantifying the large-scale and low-frequency variability of the reflected solar radiation from the Earth-atmosphere system and net outgoing longwave radiation, and their relationship to cloudiness. CERES is proposed for three applications; the U.S. polar platform, the European polar platform, and Space Station Freedom. A common design solution is being sought for the three applications.



Description:

The basic design for CERES is a modification of the Earth Radiation Budget Experiment (ERBE) scanner. CERES consists of a pair of identical broadband scanning radiometer instruments. One scanner operates in a cross-track mode to provide complete spatial coverage from limb to limb. The second scanner operates in a bilateral scan mode to provide complete angular sampling for improved model development and error reduction. Three channels on each scanner provide the following spectral information: 1) 0.3 to >100 micrometers; 2) a shortwave channel measuring reflected radiation (0.3 to 3.5 micrometers); and 3) a longwave channel measuring Earth-emitted radiation predominantly in the atmospheric window (6 to 25 micrometers).

Investigation Overview:

The CERES data will allow understanding of the relative importance of different cloud processes, such as frontal clouds, convective activity, and boundary-layer meteorology, and the way these processes interact with the Earth's climate. These data will be fundamental for experiments in long-range weather forecasting and climate prediction. The radiation will be measured as fluxes at the top of the Earth's atmosphere, at the surface and as flux divergences within the atmosphere. Cloud data will be provided in terms of measured areal coverage, altitude, condensed water density, and shortwave and longwave optical depths. The CERES scanners will provide the radiation measurements; cloud properties will then be resolved from spectral radiances obtained by companion Eos instruments and from geostationary meteorological data. The equatorial orbital trace of Space Station Freedom will allow collecting data at different times of day than that of the fixed collection time available from the Polar Platform in a sun-synchronous orbit.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1998

Principal Investigator: Bruce Barkstrom, NASA/LaRC

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Alexander Tuyahov (Acting)
Program Scientist	W. Stanley Wilson

NASA Center:

Project Manager	Charles MacKenzie (GSFC)
Project Scientist	Gerald Soffen (GSFC)

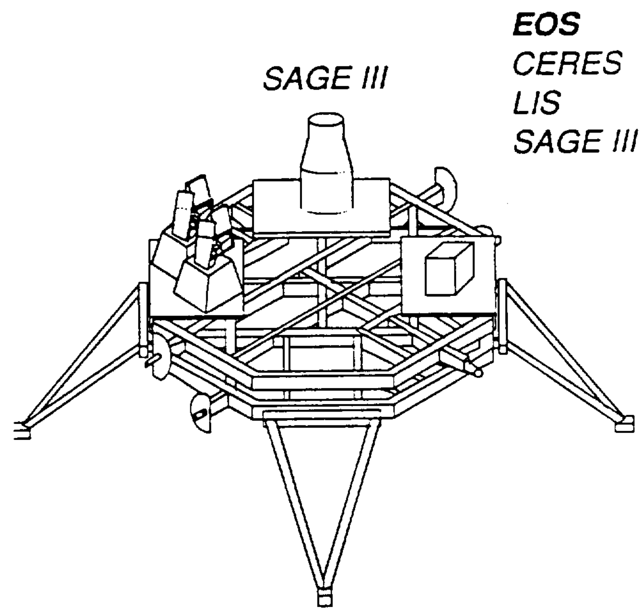
Stratospheric Aerosol and Gas Experiment III (SAGE III)

Payload Data:

Type:	Attached	***Mass:***	60 kg
Launch:	TBD	***Size:***	0.6 x 0.6 x 1.1m
Lifetime:	15 years	***View Direction:***	Earth limb viewing

Objective:

SAGE III will measure 5 of the 9 constituents of the atmosphere identified as critical by the U.S. National Plan for Stratospheric Monitoring (1988-1997). SAGE III, an Earth Observing System (Eos) payload will combine Earth limb scattering and solar occultation measurements to obtain daily coverage both from an identical instrument in a sun-synchronous orbit (Eos Polar Platform) and from diurnal measurements in the tropics from Space Station Freedom.



Description:

SAGE III is an improved version of the successful Stratospheric Aerosol Measurement II (SAM II), SAGE I and SAGE II experiments. The SAGE III instrument consists of a 4.3 centimeter diameter f/2 Cassegrain telescope, a spectrometer with a holographic flat field grating, and a 1 by 512 element charge coupled device detector. The design is based on proven techniques. Its predecessor SAM II operated for 10 years. A nine channel limb-viewing spectrometer makes direct solar radiance measurements and also measures scattered solar flux from the Earth's limb over the frequency spectrum from 290 to 1500 nanometers. SAGE III contains two modules: 1) the instrument telescope, spectrometer, and azimuth and elevation pointing system (0.3 meter diameter by 0.9 meters long), and 2) the electronics box (0.3 meter cube). The instrument views the Earth's limb at a subtended angle from 8° below local horizontal to 10°- 27° below horizontal. SAGE III is totally self-calibrating (wavelength and intensity). The instrument operates autonomously from stored spacecraft commands with no special operational requirements. It uses direct sun measurements before each sunset and after sunrise for instrument throughput calibration and uses solar Fraunhofer lines at short wavelengths for instrument spectral response calibration.

Investigation Overview:

Specific measurement objectives are to provide: 1 km vertical resolution profiles of aerosols and clouds at six wavelengths from the mid-troposphere into the stratosphere, O_3 from the mid-troposphere to 85 km, H_2O from the planetary boundary layer to 50 km, NO_2 from the troposphere to 50 km, and O_2 from the mid-troposphere to 70 km. The purpose is to investigate the spatial and temporal variabilities of these species to determine their role in climatological processing. Measurement of a transient localized event such as a dust storm or volcano could be performed on successive orbits. SAGE III will continue prior SAGE self-calibrating solar occultation data sets enabling the detection of long-term trends, and provide atmospheric data essential for the calibration and interpretation/correction of other Eos sensors.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1998

Principal Investigator: M. Patrick McCormick, NASA/LaRC

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Alexander Tuyahov (Acting)
Program Scientist	W. Stanley Wilson

NASA Center:

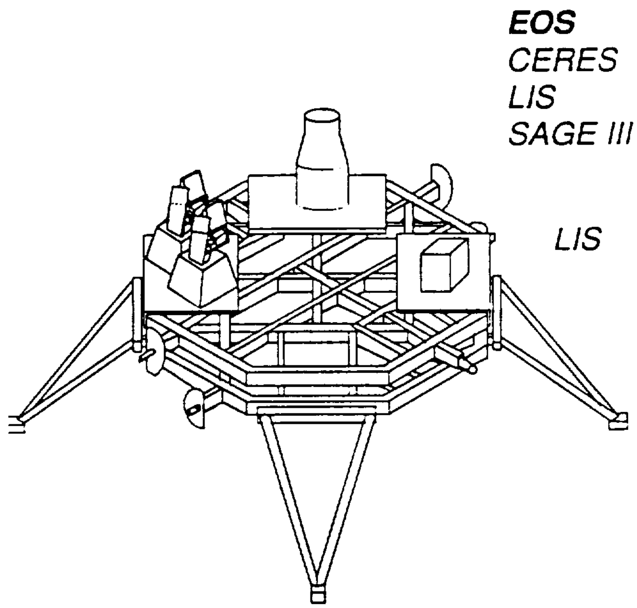
Project Manager	Charles MacKenzie (GSFC)
Project Scientist	Gerald Soffen (GSFC)

Lightning Imaging Sensor (LIS)

Payload Data:

Type: Attached
Launch: TBD
Lifetime: 5 years

Mass: 8.0 kg
Size: 0.2 x 0.15 x 0.15m
View Direction: Earth viewing/Nadir-centered



Objective:

LIS is a calibrated optical lightning sensor designed to acquire and investigate the global distribution and variability of total lightning, and to investigate underlying and interrelated phenomena including atmospheric convection, planetary-scale circulations, lightning-precipitation relations, lightning/trace gas interactions (e.g., NO_2), magnetospheric /ionospheric coupling, and the global electric circuit.

Description:

LIS is a small, light-weight, low-power sensor (typically 15w). LIS consists of a staring imager optimized to detect and locate lightning. The imaging system is a simple telescope consisting of a beam-expander, an interference filter, and imaging optics. LIS is optimized to take advantage of the significant difference in temporal, spatial, and spectral characteristics between the lightning flashes and the ambient background. A real-time processor generates an estimate of the background scene to effectively reduce the background illumination to enhance the lightning detection capability. LIS will view a total area of 640 by 640 km using a 64 by 64 charge-coupled device (CCD) array. Events are digitized, time-tagged, location tagged, and transmitted via interface electronics.

Investigation Overview:

Lightning measurements from Space Station Freedom by LIS will contribute significantly to several important Eos mission objectives. For example, lightning is closely coupled to storm convection, dynamics, and microphysics, and can be correlated to the global rates, amount, and distribution of precipitation and to the release and transport of latent heat. The goal is to detect and locate total lightning activity with a 90% detection efficiency under both daytime and nighttime conditions with a 10 km spatial storm scale, and a 1 millisecond temporal resolution, and measure the radiant energy of the lightning event. The ground-track speed of Space Station Freedom will allow LIS to monitor lightning events occurring within individual storms, and observations can then be correlated with the storm system, as detected and measured by other systems.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1998

Principal Investigator: Hugh Christian, NASA/MSFC

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Alexander Tuyahov (Acting)
Program Scientist	W. Stanley Wilson

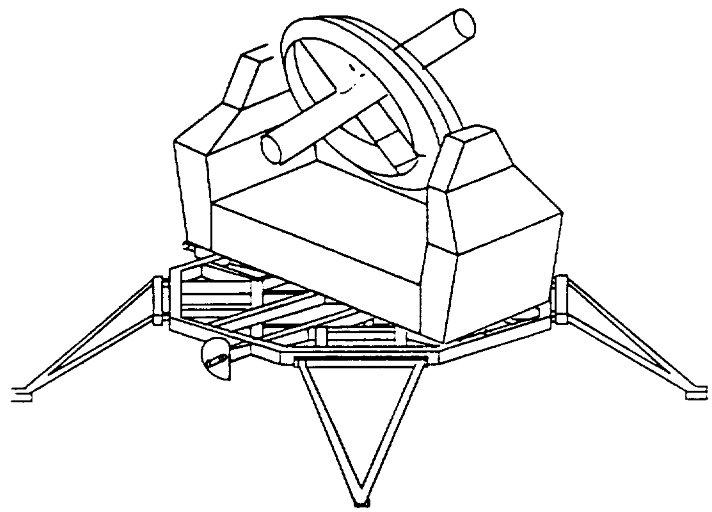
NASA Center:

Project Manager	Charles MacKenzie (GSFC)
Project Scientist	Gerald Soffen (GSFC)

Ultra-High Resolution XUV Spectroheliograph (UHRXS)

Payload Data:

Type:	Attached	***Mass:***	270 kg
Launch:	TBD	***Size:***	1.4 (diameter) x 3m (length)
Lifetime:	1 1/2 years	***View Direction:***	Solar



Objective:

Observe and study the solar chromosphere, corona, and corona/solar wind interface in the extreme ultra-violet and at a resolution sufficient to discern the physical structures controlling the dynamics of these solar elements.

Description:

UHRXS consists of eight identical Ritchey-Cretien telescopes covering the 40Å to 1600Å spectral range to be mounted on the Space Station Freedom Payload Pointing System (PPS). Image motion compensation is required for solar pointing to allow sub arc-second resolution. The XUV images are recorded on high resolution 70mm format film. Film canisters, which are approximately 14" in diameter, are robotically exchangeable. The telescopes employ multilayer optics technology and Multi-Anode Microchannelplate Array (MAMA) detectors.

Investigation Overview:

UHRXS is an ultra-high resolution XUV spectroheliograph which will address fundamental scientific problems relating to several solar phenomena which include: 1) the morphology of the fine structure of the solar chromosphere/corona interface, including the "chromospheric network," spicules, prominences, cool loops, and the magnetic field; 2) the structure, energetics, and evolution of high temperature coronal loops; 3) the large scale structure and dynamics of the corona, including the solar wind interface (e.g., polar plumes) the coronal magnetic field, and coronal mass ejections; and 4) solar flares, especially the evolution of the pre-flare state, the nature of the impulsive energy release, and the evolution of the post-flare loops.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1999

Principal Investigator: Arthur B. C. Walker, Jr., Stanford University

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Louis Demas
Program Scientist	David Bohlin

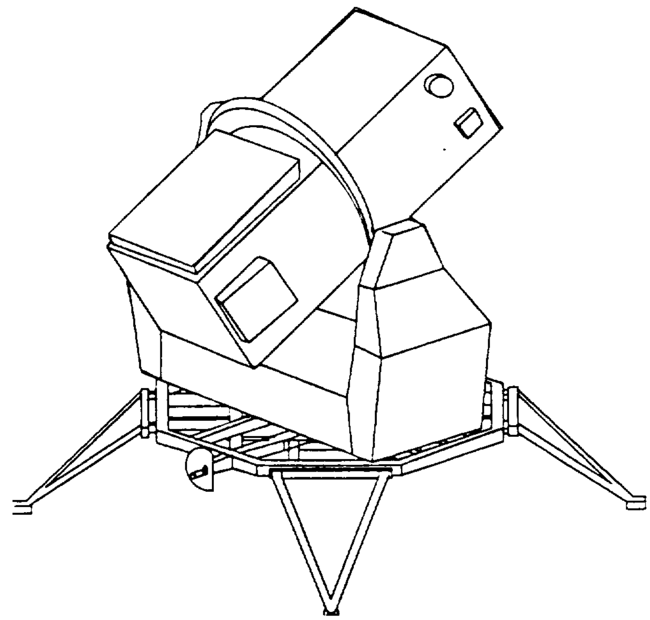
NASA Center:

Project Manager	TBD
Project Scientist	TBD

Large Area Modular Array of Reflectors (LAMAR)

Payload Data:

Type:	Attached	***Mass:***	5400 kg
Launch:	TBD	***Size:***	2 x 2 x 5.4m
Lifetime:	1 year	***View Direction:***	Celestial



Objective:

LAMAR is a high-throughput x-ray telescope/high-resolution spectrometer system which will allow the study of a wide class of astrophysical problems beyond the reach of other current or planned x-ray instruments. The principal thrusts will be in the area of sensitive imaging, timing, and spectral studies of distant and faint x-ray emitting systems.

Description:

LAMAR is a modular x-ray imaging telescope/spectrometer system to be mounted on the Space Station Freedom Payload Pointing System (PPS). LAMAR consists of 25 co-aligned, grazing-incidence telescope modules which provide a net effective area of 3200 cm^2 (1 keV). Each module contains a Kirkpatrick-Baez telescope, a stack of reflection gratings and a dual section multi-wire position-sensitive gas proportional counter. One section detects the image, the other the dispersed spectrum. For imaging, LAMAR has a moderate angular resolution of 30 seconds (half power width) and covers the band from 0.15 to 10 keV(thousand electron-volts). For spectroscopy, LAMAR has an energy resolution that is typically 0.5% in the 0.15 to 2 keV band. The instrument viewing direction is all sky celestial and the field-of-view is 40 arc-minutes. A mixture of gas (90% methane, 10% xenon) is supplied under low pressure to the proportional counters.

Investigation Overview:

Lamar is a versatile instrument capable of conducting a wide range of astrophysical investigations. Among its scientific objectives are studies of:

(1) clusters of galaxies: Determination of the spectrum and spatial distribution of the hot intercluster gas to investigate the important issue of the amount and nature of "dark matter" in these systems, the presence of which has been indicated by earlier x-ray observations;

(2) active galactic nuclei (AGN): Observation of short timescale variations (~ 500 seconds) in the x-ray emission from AGN and quasars to obtain important clues to the nature of the mechanism responsible for the intense emission, and of the underlying compact object, presently thought to be a massive black hole;

(3) stellar coronal: Investigation of the mechanism(s) responsible for the prodigious x-ray emission produced by the coronae of cool stars using the high sensitivity and spectral capability of LAMAR; and,

(4) x-ray binaries: Identification of new clues into the physics of the accretion process which fuels these systems during the late stages of binary star evolution, and into the interaction between a plasma and a strong neutron star magnetic field, using LAMAR's large collecting area and corresponding timing and spectral capabilities

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1998

Principal Investigator: Paul Gorenstein, Smithsonian Astrophysical Observatory

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Louis Kaluzienski (Acting)
Program Scientist	Louis Kaluzienski (Acting)

NASA Center:

Project Manager	TBD
Project Scientist	TBD

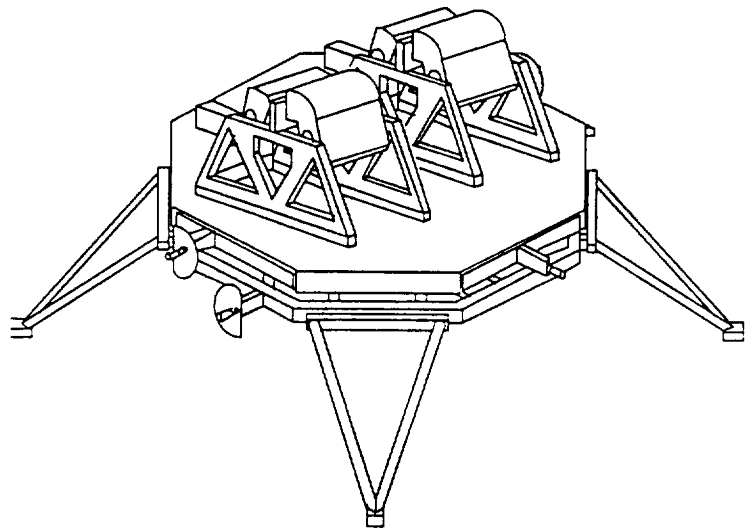
X-ray Background Survey Spectrometer (XBSS)

Payload Data:

Type:	Attached	*Mass:*	1770 kg
Launch:	TBD	*Size:*	2.43 x 2.4 x 1.5m
Lifetime:	1 year	*View Direction:*	Celestial

Objective:

XBSS is an x-ray survey instrument designed to measure the energy spectrum of diffuse soft x-ray emitting regions of the interstellar medium and deduce temperature, elemental, and ionic abundances. XBSS will build on the data base which will be provided by the Diffuse X-ray Spectrometer (DXS) experiment for the NASA Shuttle High Energy Astrophysics Laboratory (SHEAL) Program planned for flight in 1991.



Description:

The XBSS design is based on the existing NASA-qualified University of Wisconsin DXS instrument. The XBSS instrument consists of six major elements: rotating detectors, electrical interface assembly, control electronics assembly, power control assembly, gas tank, and gas system manifold. Several mechanically-oscillating Bragg Crystal reflector/detector modules are mounted on the same structure to obtain a wide field-of-view and spectral coverage. Each detector will continuously leak a small quantity of P-10 (90% argon, 10% methane) gas through the detector window. Resupply of the P-10 source will be required for extended operation. The detectors must be stowed prior to orbital sunrise to avoid destruction of the Bragg Crystal scattering reflectors by UV and visible light.

Investigation Overview:

XBSS measures the low energy diffuse x-ray background from each of several regions in the night sky. With wavelength ranges of 11-24Å and 44-84Å, the XBSS will collect spectral information on the hot plasma ($\sim 10^6$ K) present in the interstellar medium. This spectral line data will determine the temperature, ionization states, and elemental composition of the hot plasma. The survey will be conducted during the night observational period as the instrument scans in the celestial (anti-Earth) direction.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1996

Principal Investigator: W. T. Sanders, University of Wisconsin

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Louis Kaluzienski (Acting)
Program Scientist	Louis Kaluzienski (Acting)

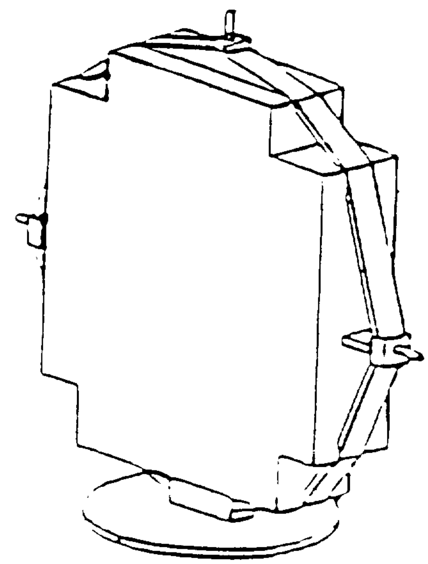
NASA Center:

Project Manager	TBD
Project Scientist	TBD

Heavy Nuclei Collector (HNC)

Payload Data:

Type:	Attached	*Mass:*	3400 kg
Launch:	TBD	*Size:*	5 (diameter) x 3m
Lifetime:	2 1/2 years	*View Direction:*	Celestial



Objective:

The HNC is an array of passive glass detectors to study the origin of ultra-heavy cosmic rays. It will determine the relative abundances of odd and even charged cosmic ray nuclei, search for highly ionizing particles, such as super-heavy elements, and attempt to determine the sources of ultra-heavy cosmic rays.

Description:

The HNC is completely passive and requires no electrical power. It consists of trays, stacked with phosphate glass. The glass sheets (14 sheets per tray) record the tracks of the cosmic rays as they either pass through or are captured in the glass and disintegrate. The glass detectors are recovered and returned to Earth for analysis. The analysis consists of etching in the individual glass sheets and measuring the latent cosmic ray tracks, to derive the mass and energy data. This technique, which originally used plastic detectors, was developed by the HNC principal investigator. Phosphate glass has better nuclear charge resolution than plastic detectors and is less sensitive to orbital thermal variations experienced by Space Station Freedom. Glass is also less sensitive to over-exposure to space radiation, and therefore can remain in space longer. The glass stacks are mounted like windows in the trays so that both sides of the sheets are exposed to space. The HNC will be mounted in the anti-Earth direction.

Investigation Overview:

The HNC data will be used by the investigators to better understand the synthesis of cosmic rays whose nuclear masses range from hydrogen to, and possibly exceeding uranium. The heaviest particles (actinides) are short-lived on a cosmic scale, so their relative abundances can yield major new information on the nucleosynthesis mechanisms and the astronomical environment in which they were created. The HNC detector array will have cumulative collection power equivalent to flying 32 m^2 of detectors in space for 4 years. With only 14 layers of glass as compared to 120 layers of plastic, the post-flight mission can be accomplished with only two institutions doing the etching, scanning and measuring, and with one other institution participating in the interpretation.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1996

Principal Investigator: P. Buford Price, University of California, Berkeley

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Louis Demas
Program Scientist	W. Vernon Jones

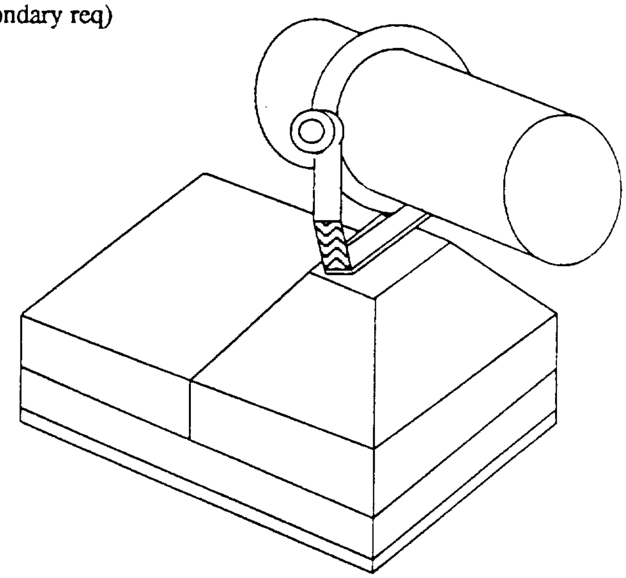
NASA Center:

Project Manager	TBD
Project Scientist	TBD

Laser Communications Transceiver (LCT)

Payload Data:

Type:	Attached	***Mass:***	84 kg
Launch:	TBD	***Size:***	0.75 x 0.55 x 1m
Lifetime:	1 year	***View Direction:***	Earth limb to limb preferred (primary req)
			Space Viewing (secondary req)



Objective:

LCT will conduct a broad class of experiments in optical communications and will provide verification and validation of high-data-rate optical communication systems and supporting technologies for future application to science platforms, satellite crosslinking and commercial satellite networking.

Description:

LCT is a low power laser transceiver consisting of three basic components: 20 cm telescope and gimbal unit; focal plane optics; and electro-optics. Multiple transmitter and receiver modules with different technologies will share a common optical bench and telescope. The performance of competing technologies will be evaluated and compared. The instrument looks in the nadir (Earth) direction to accomplish its primary objectives.

Investigation Overview:

Communications tests will involve testing a range of data rates and combining multiple channels of 300 to 600 Mbps to achieve Gbps data transfer from LCT to the ground station. The most important mode is with LCT operating with an Earth-based IR laser (8000 Å) transceiver where the overall performance of a mutual acquisition sequence, mutual tracking and pointing, and duplex communication can be demonstrated and measured. The space viewing secondary requirement will allow experiments with geosynchronous orbit assets if they become available in the LCT operational timeframe. Space viewing will also allow for the planned experiments in stellar object acquisition and tracking.

Schedule:

Definition Phase	TBD
Preliminary design	TBD
Delivery to KSC	TBD
Launch readiness date	1996

Principal Investigator: Michael Fitzmaurice, NASA/GSFC

Management:

NASA Headquarters:

Program Manager (Attached Payloads)	Mark Sistilli
Program Manager	Louis Caudill
Program Scientist	TBD

NASA Center:

Project Manager	TBD
Project Scientist	TBD